

REMARKS

Offer to Surrender

At page 2, item 1 of the Office Action, the Examiner noted that the reissue application was filed without the required offer to surrender the original patent. Pursuant to 37 CFR § 1.178 and MPEP § 1416, Applicants respectfully request that examination of the reissue continue and upon notice of allowance will surrender the original patent itself, or if the original is lost or inaccessible, file a statement to that effect.

Written Consent

At page 2, items 2 and 3 of the Office Action, the Examiner noted that the reissue application was lacking written consent of all assignees owning an undivided interest in the patent. Applicants hereby submit written consent of KLA-Tencor, the sole assignee, of the patent as signed by a party authorized to act on behalf of the assignee.

Preliminary Amendments

At page 3, item 4 of the Office Action, the Examiner requested the amendments filed on October 10, and November 20, 2000, be placed in proper form pursuant to 37 CFR 1.173. As requested by the Examiner, Applicants hereby supplement the previous preliminary amendments by placing the amendments in proper form, pursuant to 37 CFR 1.173, as part of this Office Action response.

As indicated above, the specification was amended in two places. First, a paragraph was added to include the reference to the co-pending reissue application, Serial No. 09/502,534. Second, the specification was amended at col. 11, line 21 to correct a typographical error in which "mA" was inadvertently written as "Ma."

Applicants reiterate that the amended claims, claims 35-41 and 44-49, were copied from U.S. Patent No. 6,091,249 entitled "Method and Apparatus for Detecting Defects in Wafers," by Talbot et al., which patent issued on July 18, 2000. A copy of U.S. Patent No. 6,091,249 was provided to the Examiner as part of Applicants' submission on October 3, 2000.

Claim 35 is amended from its previous version as indicated below:

35. A method [for] of detecting electrical defects in a die on a semiconductor wafer, comprising:

- a) applying charge to a predetermined region of the wafer such that electrically isolated structures in the [die] predetermined region are raised to a voltage relative to electrically grounded structures;
- b) probing a portion of the predetermined region so as to obtain voltage contrast data for the structures in the portion of the predetermined region [of the die]; and
- c) analyzing the voltage contrast data to detect structures at [a] voltages different [to predetermined voltages] from reference voltages that would be anticipated for such structures if such a charge were applied and the structures were non-defective, thereby identifying defective structures;

wherein the step of applying the charge is performed so as to apply charge to the predetermined region at a significantly lower resolution than the resolution at which the region is probed.

Support for each of these amendments is found in the specification. Support for the amendments related to the "predetermined region" or "a portion of the predetermined region" is found, for example, at col. 5, lines 51-54, which states "[w]ithin die 64 there is a care area 65, or area of significance, that is to be inspected."

Support for the amendments to step c) of claim 35 can be found at, for example, col. 4, lines 54-63, which states:

The inspection system has two modes of operation: die-to-die and die-to-database. In both modes, defects are detected by comparing an electron beam image derived from scanning the substrate against a standard. In die-to-die inspection, signals from two dice of the same substrate are compared with each other, while in die-to-database inspection the signal from one die derived from the electron microscope is compared with a signal that is derived from the database which typically is the one that was used to make the die.

As noted in the above section, Applicants' invention analyzes the voltage contrast data to detect defective structures by comparing the voltage contrast data from the predetermined care area with the voltage contrast date from a reference, which reference may be another die scan or data from a database.

Each of claims 36-40 is similarly amended. Claim 36 is herein amended from its previous version by replacing the phrase "the region of the die" with "the predetermined region." Claims 37-39 are herein amended from the previous versions by including "predetermined" before "region." Claim 40 is herein amended from its previous version by replacing the phrase "the region of the die" with "the portion of the region." As noted above, Applicants' specification supports such amendments, for example, at col. 5, lines 51-54, which discloses that the die contains a care area, or area of significance, upon which the present invention operates to determine if it contains a defect or defects.

Claim 41 is herein amended from its previous version by replacing "predetermined" with "reference." As noted above, Applicants' specification supports such an amendment. For example, col. 4, lines 54-63, discloses that the Applicants' invention can compare the voltage contrast image with a reference image taken from either another die or from a signal that is derived from a database.

Claim 44 is amended from its previous version as indicated below:

44. Apparatus for detecting electrical defects in a die on a semiconductor wafer, comprising:

- a) means for applying charge to a predetermined region of the wafer such that electrically isolated structures in the die are raised to a voltage relative to electrically grounded structures;
- b) a probe, having [a] significantly higher resolution than the means for applying charge, for obtaining voltage contrast data for a portion of the predetermined region [of the die] containing such structures; and
- c) means for determining reference voltages for such structures, should they be so charged and should they be non-defective; and
- [c)] d) means for analyzing the voltage contrast data to detect structures at [a] voltages different [to predetermined] from the reference voltages for such structures, thus determining which structures are defective.

Applicants note that the amendments made to claim 44 are similar in nature to those changes made to claim 35. Thus, the support in Applicant's specification provided above with respect to claim 35 also satisfies the requirements of 35 CFR § 173 with respect to these amendments.

Claim 45 is herein amended from its previously version by deleting the phrase "the region of" before "the die" so that the claim reads, in part, "the probe comprises an electron beam probe arrangement which scans an electron beam across the die." Support in the Applicants' specification is found, for example, in Figures 2-3d and in the accompanying description to those figures (col. 5, line 49 – et seq.). Figures 2-3d depict the electron beam scans across a die or dies.

Claim 46 is amended herein to change its dependency from claim 44 to claim 45. Claim 46 is also amended herein by replacing "region" with "die." Applicants note that this amendment is to make claim 46 consistent with claim 45 from which it depends, and therefore, the support provided for claim 45 also applies to this amendment.

Claim 47 is amended herein by insertion of “predetermined” before “region.” Applicants note that this amendment is to make claim 47 consistent with the claims from which it depends, and therefore, the support provided for claims 44 and 45 also apply to this amendment.

Claim 48 is herein amended wherein “obtained” is replaced by “taken” and the phrase “portion of the predetermined” is inserted before “region with voltage contrast data....” As noted previous with respect to claim 35, Applicants’ specification discloses die-to-die inspection. See, e.g., col. 4, lines 54–63. Furthermore, Applicants disclosed comparing regions to determine if defects exist. For example, the specification states at col. 25, lines 31–32, that “to detect defects, it is only necessary to perform a region by region examination and comparison.” See generally, col. 22, line 16–et seq., for description related to the inspection of masks.

Claim 49 is amended from its previous version as indicated below:

49. Apparatus for detecting electrical defects in a device on a semiconductor wafer, having some structures at ground voltage and other structures at a floating voltage relative to ground comprising:

- a) a charged particle beam probe for scanning a charged particle beam across a predetermined region of [the] a surface of the device in a series of spaced scan lines so as to intersect structures in the device;
- b) a secondary particle detector for obtaining voltage contrast data for the scan lines; and
- c) means for analyzing the voltage contrast data to determine the presence of a structure at a different voltage [to a predetermined voltage] from a reference voltage for that structure should the structure be so charged and non-defective, thus identifying defective structures.

One way in which the amendment to the preamble of claim 49 is supported is found at, for example, col. 22, line 35–et seq., which discloses applying a thin electrically conductive layer on all exposed top surfaces of the mask. This conductive layer is then electrically grounded to

provide an electrical return path for the electrons that are not backscattered or produced secondarily. All electrically conductive structures on the surface of the mask are grounded, but other structures, not in contact with the conductive layer may not be grounded. Concerning the amendments made to item c) of claim 49, Applicants note that these amendments are the same in nature to those amendments made to claim 35. Thus, the support in Applicant's specification provided above with respect to claim 35 also satisfies the requirements of 35 CFR § 173 with respect to these amendments in claim 49.

Oath/Declaration

At page 3, item 5 of the Office Action, the Examiner stated that the reissue oath/declaration is defective because it fails to contain a statement that the inventor "the original, first and sole" or "the original, first and joint" inventor as required by 37 CFR 1.63(a)(4). Applicants respectfully disagree. In Applicants' *Response to Notice to File Missing Parts of Reissue Application*, mailed October 2, 2002, each Applicant's declaration included the following statement (as found on Form PTO/SB/51, page 1):

I believe I am the original, first and sole inventor (if only one name is listed below) or ***an original, first and joint inventor*** (if plural names are listed below) of the subject matter which is described and claimed in patent number 5,717,204, granted February 10, 1998...

Reissue Application Declaration by the Inventors, as submitted on October 2, 2000 as part of the *Response to Notice to File Missing Parts of Reissue Application* (emphasis added).

At page 3, item 5 of the Office Action, the Examiner also stated that the reissue oath/declaration is defective because it fails to contain a statement that all errors which are being corrected in the reissue application up to the time of filing of the oath/declaration arose without any deceptive intention on the part of the application. Applicants respectfully disagree. In

Applicants' *Response to Notice to File Missing Parts of Reissue Application*, mailed October 2, 2002, each Applicant's declaration included the following statement (as found on Form PTO/SB/51, page 2):

All errors corrected in this reissue application arose without any deceptive intention on the part of the applicant.

Reissue Application Declaration by the Inventors, as submitted on October 2, 2000 as part of the *Response to Notice to File Missing Parts of Reissue Application*.

At page 3, item 6 of the Office Action, the Examiner stated that Claims 9-51 are rejected based upon a defective reissue declaration. In light of the response set forth above which addresses all aspects of the defective reissue declaration, Applicants hereby respectfully request removal of the rejection of Claims 9-51 based upon the reissue declaration.

Objected Informalities

At pages 3-4, item 7 of the Office Action, the Examiner objected to claims 12, 17, 33, and 46. Applicants hereby amend claims 12, 17, 33, and 46 as suggested by the Examiner. At line 1 of claim 12, "to flood" is herein deleted and replaced with "floods." At line 2 of claim 17, "bean;" is herein deleted and replaced with "beam." Claim 33, line 2 is herein amended to insert "an" between "applying" and "electron beam." At line 2 of claim 46, the word "detecting" is herein inserted between "for" and "secondary electrons." Applicants also amend herein claim 10, wherein "bean" was deleted and replaced with "beam." Finally, Applicants also amend herein claim 34 to place it in proper dependency from claim 33 rather than claim 35. Applicants note that since each of the above listed amendments are to correct minor typographical or grammatical errors, the requirement of 37 CFR § 173(c) to provide support for the amendments is inapplicable.

Objected Drawings

At page 4, item 8 of the Office Action, the Examiner objected to the drawings under 37 CFR 1.83(a) for not showing every feature. Applicants respectfully disagree.

The first item cited as missing from the drawing is the means for obtaining the voltage contrast data in the form of an image as recited in claim 18. Applicants note that Figure 1 discloses the overall system, which includes a means for obtaining the voltage contrast data in the form of an image. Detectors 32 receive the voltage contrast data from the substrate 57 when scanned by beam 100 generated by column 20. The data is arranged in an image though the memory 52 and acquisition pre-processor 48 and can be displayed on image display 46.

Second, the Examiner cites that the means for controlling the temperature of the structure during the test as recited in claim 20 is not shown. Applicants respectfully disagree. Figures 3b-3d depicted an embodiment of the multiple scan techniques which can control the temperature for temperature-sensitive substrates as noted in the specification:

for some temperature-sensitive substrate materials, it is desirable to have a time interval between beam scans of a pixel site in order to permit the heat deposited by the beam to dissipate.

Col. 6, lines 55-58.

Third, the Examiner cites that the grid electrode as recited in claim 25 is not shown. Applicants respectfully disagree. Figures 4 and 12 depicted electrode 107 which can function as a grid electrode.

Finally, the Examiner cites that a sample plate and the voltage applied to the sample plate are recited in claim 27 is not depicted. Applicants respectfully disagree. Figure 4 depicts sample plate 20 and voltage power supply 114 connect to the sample plate 20.

Applicants respectfully submit that all features are depicted in the drawings and respectfully request removal of these objections.

Rejections Under 35 U.S.C. § 112 ¶1

At pages 4-6, item 9 of the Office Action, the Examiner rejected claims 9-51 under 35 U.S.C. § 112 ¶1, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art the inventors, at the time the application was filed, had possession of the claimed inventions. Applicants respectfully disagree. Applicants note that the following explanations are to provide at least one supporting reference in the specification for an interpretation of the claims. The following explanations are not intended to limit the support or interpretation of the claims to just those provided below.

Claim 9

Claim 9 recites a method of testing a semiconductor structure, the method comprises: a) charging an element of the semiconductor structure; b) applying an electric field perpendicular to a surface of the structure while charging so as to determine charging potential and polarity; c) interrogating the structure including the charged element with a charged particle beam so as to obtain voltage contrast data for the structure; and d) analyzing the data to determine the functionality of the element. The Examiner asserts that steps b), c), and d) are not found in the specification. Applicants respectfully disagree.

Concerning step b), the specification discloses applying an electric field perpendicular to a surface of the structure. The electric field is created by the potential difference between intermediate electrode 107 and the stage 24 and substrate 57. See, e.g., col. 9, lines 46-51 (“Stage 24, substrate 57 and lower lens pole piece 106 are floated a few hundred volts negative by power supply 111 so that secondary electrons are accelerated to this energy before passing through deflectors 112 and 113. The intermediate electrode 107 is biased positive with respect to

the stage via supply 115"). The specification further discloses that this electric field is important to the function to the present invention:

If the electric field near the surface of substrate 57 can be controlled, in this case by the potential upon intermediate electrode 107, secondary electrons can be encouraged to leave that surface or return to it, depending upon the applied field and the energy that they leave with. For example if an approximately 10 eV retarding potential barrier is established, then only some of the secondaries emitted from a point on the surface 57 would escape to the detector.

Col. 12, lines 51-55.

Applicants respectfully submit that the specification discloses claim element b).

Concerning step c), the specification discloses interrogating the structure including the charged element with a charged particle beam so as to obtain voltage contrast data for the structure. The abstract of the specification clearly states that as part of the present invention:

An electron beam is directed at the surface of a mask for scanning that mask and detectors are provided to measure the secondary and backscattered charged particles from the surface of the mask.

Abstract, lines 4-7.

The measurement of the secondary and backscattered charged particles represent voltage contrast data which is used to generate an image of the scanned mask. For example, as part of the illustration of the die-to-die mode, the specification discloses:

as the electron beam scans a swath of dice 68 and 70, signals 33 from the three types of detectors are transmitted to acquisition pre-processor 48 where they are converted to digital signals

Col. 8, lines 2-5.

Concerning step d), the specification discloses analyzing the data to determine the functionality of the element. The signal information obtained in step c) is analyzed to determine functionality of the element, i.e. whether it is properly formed or defective. Illustrations of how

the data is analyzed to determine the functionality of the element, including identification of elements, is disclosed at col. 22, line 16 – et seq., in conjunction with Figures 13 – 18.

Applicants respectfully submit that the specification adequately discloses the claim elements of claim 9 and hereby request withdrawal of the rejection of claim 9.

Claim 16

Claim 16 recites a method as claimed in claim 9 further comprising applying the electric field so as to charge the element with a negative potential. The Examiner asserts that support for this claim is not found in the specification. Applicants respectfully disagree. The specification discloses:

If the number of escaping secondary and backscattered electrons is less than the number of primary electrons, the surface will charge negatively, which will lower the retarding potential barrier created by electrode 107.

Col. 12, line 66 – col. 13, line 3.

Applicants respectfully submit that the specification adequately discloses the claim elements of claim 16 and hereby request withdrawal of the rejection of claim 16.

Claim 17

Claim 17, as amended herein, recites a method as claimed in claim 9 wherein the interrogating step c) comprises scanning the charged particle beam over the structure and detecting resulting secondary electrons so as to obtain voltage contrast data. The Examiner asserts that support for this claim is not found in the specification. Applicants respectfully disagree. As discussed above with respect to claim 9, the specification clearly discloses scanning the substrate with a beam and detecting the resulting secondary electrons so as to generate voltage contrast data. Applicants respectfully request withdrawal of the rejection of claim 17.

Claims 18 and 40

Both claim 18 and claim 40 recite that the voltage contrast data is arranged in an image. The Examiner asserts that support for these claims is not found in the specification. Applicants respectfully disagree. The specification clearly contemplates that the scanned data be organized into an "image." Indeed, "defects are detected by comparing an electron beam **image** derived from scanning the substrate against a standard." Col. 4, lines 55-57. The following passage is a further example that the voltage contrast data obtained from the scan is arranged and displayed in an image:

as the electron beam scans a swath of dice 68 and 70, signals 33 from the three types of detectors are transmitted to acquisition pre-processor 48 where they are converted to digital signals for storage in memory block 52. Data from dice 68 and 70 are simultaneously transmitted to defect processor 56 where any significant discrepancy between the two data streams is then designated as a defect. The accumulation of the defect data from the defect processor 56 is then transferred and consolidated in post-processor 58. It is the post-processor that determines the size and various characteristics of the defects and makes that information available to system computer 36 via bus 23....

After the entire substrate has been inspected, a list of defects, together with their locations, is displayed on computer display 38, and the operator can then initiate a defect review via keyboard 40. In response to this command, system 10 locates and scans the neighborhood of each defect and displays the image to the operator on image display 46.

Col. 8, lines 2-24.

Applicants respectfully submit that the specification adequately discloses the claim elements of claims 18 and 40 and hereby request withdrawal of the rejections of claims 18 and 40.

Claim 20

Claim 20 recites the method as claimed in claim 9 but further comprising controlling the temperature of the structure during the test. The Examiner asserts that support for this claim is not found in the specification. Applicants respectfully disagree. The specification discusses using multiple scan techniques to control the temperature for temperature-sensitive substrates:

for some temperature-sensitive substrate materials, it is desirable to have a time interval between beam scans of a pixel site in order to permit the heat deposited by the beam to dissipate.

Col. 6, lines 55-58.

Applicants respectfully submit that the specification adequately discloses the claim elements of claim 20 and hereby request withdrawal of the rejection of claim 20.

Claim 21

Claim 21 recites an apparatus for testing semiconductor structures. The apparatus of claim 21 comprises: a) means for applying charge to an element of the semiconductor structure; b) an electric field generator which applies an electric field perpendicular to a surface of the structure so as to determine the potential and polarity of the charge applied to the element; c) a charged particle beam device for interrogating the charged element; and d) a detector which obtains voltage contrast data from the structure on interrogation with the charged particle beam. The Examiner asserts that support for claim elements b) and d) are not found in the specification. Applicants respectfully disagree.

Concerning claim element b), the specification discloses an electric field generator which applies an electric field perpendicular to a surface of the structure so as to determine the potential and polarity of the charge applied to the element. As previously mentioned with respect to claim 9, step b), electrode 107 (in conjunction with power supply 115) act as an electric field generator which applies an electric field perpendicular to the substrate 57. See col. 9, lines 46-51. The

electric field can be varied to determine the potential and polarity of charging of the substrate.

See col. 12, lines 51–et seq.

Concerning claim element d), the specification discloses a detector which obtains voltage contrast data from the structure upon interrogation with the charged particle beam. As previously mentioned, the present invention includes a number of detectors which obtain voltage contrast data from the structure on interrogation with the charged particle beam. For example, Figure 4 illustrates detectors 117, 160, and 129, each of which are intended to receive signals (secondary electrons, backscatter electrons, and transmission electrons, respectively) when the substrate is scanned with a charged particle beam. See also the corresponding written description explaining the elements of Figure 4, which is found at col. 9, line 19 – col. 14, line 14.

Applicants respectfully submit that the specification adequately discloses the claim elements of claim 21 and hereby request withdrawal of the rejection of claim 21.

Claim 27

Claim 27 recites an apparatus for testing semiconductor structures. The apparatus of claim 27 comprises a sample plate on which the structure is positioned and a voltage being applied between the electrode and the sample plate. The Examiner asserts that support for this claim is not found in the specification. Applicants respectfully disagree. The specification discloses a sample plate for holding the structure. Stage 24 is depicted in Figures 1, 4, 7, 8, and 12. See also col. 4, lines 64–66 (“Substrate 57 to be inspected is held in a holder which is automatically placed beneath electron beam column 20 on x-y stage 24 by substrate handler 34.”). A voltage is applied between the electrode (electrode 107) and the sample plate (stage 24) by power supplies 115 and 111. See discussions of claims 9 and 21, above, for further support

that a voltage is applied between electrode 107 and stage 24 in order to generate an electric field.

Applicants respectfully submit that the specification adequately discloses the claim elements of claim 27 and hereby request withdrawal of the rejection of claim 27.

Claim 29

Claim 29 recites an apparatus for testing semiconductor structures. The apparatus of claim 29 comprises the apparatus of claim 27 wherein the electrode is grounded and the voltage at the sample plate is selected to determine the potential and polarity of charging. The Examiner asserts that support for this claim is not found in the specification. Applicants respectfully disagree. The specification discloses that the stage/sample plate is biased at a negative voltage. See col. 9, lines 46-47 (“Stage 24, substrate 57 and lower lens pole piece 106 are floated a few hundred volts negative by power supply 111”). The specification further discloses that “electrode 107 is biased positive with respect to the stage via supply 115.” Col. 9, lines 49-51 (emphasis added). Since ground is positive with respect to the stage when it is floated at a negative voltage, the specification inherently discloses grounding the electrode 107. Applicants respectfully submit that the specification adequately discloses the claim elements of claim 29 and hereby request withdrawal of the rejection of claim 29.

Claim 30

Claim 30 recites an apparatus for testing semiconductor structures. The apparatus of claim 30 comprises the apparatus of claim 24 wherein the voltage between the electrode and the stage can be varied to determine the potential and polarity of the charge applied to the element. The Examiner asserts that support for this claim is not found in the specification. Applicants respectfully disagree. The specification discusses varying the voltage of electrode 107. For example, the specification discloses at col. 12, line 4 – et seq. that the voltage of the electrode

can be varied which then determines the potential and polarity of the charge on the semiconductor surface. Applicants respectfully submit that the specification adequately discloses the claim elements of claim 30 and hereby request withdrawal of the rejection of claim 30.

Claim 32

Claim 32 recites an apparatus for testing semiconductor structures, the apparatus including a display that displays the voltage contrast data. The Examiner asserts that support for this claim is not found in the specification. Applicants respectfully disagree. The specification clearly discloses an image display. See Figure 1, element 46. Furthermore, as discussed with respect to claims 18 and 40, the voltage contrast data obtained from the scan is arranged and displayed:

After the entire substrate has been inspected, a list of defects, together with their locations, is displayed on computer display 38, and the operator can then initiate a defect review via keyboard 40. In response to this command, system 10 locates and scans the neighborhood of each defect and displays the image to the operator on image display 46.

Col. 8, lines 2-24.

Applicants respectfully submit that the specification adequately discloses the claim elements of claim 32 and hereby request withdrawal of the rejection of claim 32.

Claim 33

Claim 33, as amended herein, recites a method of testing a semiconductor structure. The method comprises: a) applying an electron beam of relatively low energy relative to the structure to negatively charge electrically floating portions of the structures; b) interrogating the structure including the charged portions with a charged particle beam so as to obtain voltage contrast data for the structure; and c) analyzing the data to determine the functionality of the structure. The

Examiner asserts that support for steps a), b), and c) are not found in the specification.

Applicants respectfully disagree.

Concerning step a), the specification discloses applying an electron beam of relatively low energy relative to the structure to negatively charge electrically floating portions of the structures. One method in which the low energy electron beams are applied to the structure is disclosed at col. 12, lines 4 – et seq. That section discloses the application of low energy electron upon the surface to affect the charging of the surface.

Concerning step b), the specification discloses interrogating the structure including the charged portions with a charged particle beam so as to obtain voltage contrast data for the structure. The abstract of the specification clearly states that as part of the present invention:

An electron beam is directed at the surface of a mask for scanning that mask and detectors are provided to measure the secondary and backscattered charged particles from the surface of the mask.

Abstract, lines 4-7.

The measurement of the secondary and backscattered charged particles represent voltage contrast data which is used to generate an image of the scanned mask. For example, as part of the illustration of the die-to-die mode, the specification discloses:

as the electron beam scans a swath of dice 68 and 70, signals 33 from the three types of detectors are transmitted to acquisition pre-processor 48 where they are converted to digital signals

Col. 8, lines 2-5.

Concerning step c), the specification discloses analyzing the data to determine the functionality of the structure. Applicants' invention includes analyzing the voltage contrast waveforms by comparing a scanned image against a standard to determine if the structure contains non-functional (i.e. defective) elements. See col. 22, line 16 – et seq., which discusses the different embodiments of the inspection of masks; see col. 4, lines 55-57 ("defects are

detected by comparing an electron beam image derived from scanning the substrate against a standard"). Applicants respectfully submit that the specification adequately discloses the claim elements of claim 33 and hereby request withdrawal of the rejection of claim 33.

Claim 34

Claim 34, as amended herein, recites a method of testing a semiconductor structure as claimed in claim 33 but wherein the electron beam has an energy which is less than 20 V relative to the semiconductor structure. Applicants respectfully disagree. For example, col. 12, lines 50-60 of the specification discloses that electrons with energy below, for example, approximately 10 eV will be retarded by the potential barrier and return to the surface of the substrate. Applicants respectfully submit that the specification adequately discloses the claim elements of claim 34 and hereby request withdrawal of the rejection of claim 34.

Claim 35

Claim 35, as amended herein, recites a method for detecting electrical defects in a die on a semiconductor wafer, comprising: a) applying charge to a predetermined region of the wafer such that electrically isolated structures in the predetermined region are raised to a voltage relative to electrically grounded structures; b) probing a portion of the predetermined region so as to obtain voltage contrast data for the structures in the portion of the predetermined region of the die; and c) analyzing the voltage contrast data to detect structures at voltages different from reference voltages that would be anticipated for such structures if such a charge were applied and the structures were non-defective, thereby identifying defective structures. The Examiner asserts that support for steps b) and c) of this claim are not found in the specification. Applicants respectfully disagree.

Concerning step b), the specification discusses that beam 100 scans a portion of the substrate so as to obtain data from the structure on the substrate. See, for example, Figures 2–5. Furthermore, the abstract of the specification states that as part of the present invention:

An electron beam is directed at the surface of a mask for scanning that mask and detectors are provided to measure the secondary and backscattered charged particles from the surface of the mask.

Abstract, lines 4–7.

Concerning step c), the specification discloses that “defects are detected by comparing an electron beam image derived from scanning [i.e., the data obtained in step b] the substrate against a standard.” Col. 4, lines 55–57.

Applicants note that the Examiner’s objections to this claim are similar to those objections made with respect to claim 9 and 33. Applicants note that the support provided for those claims also applies with respect to this claim 35. Given the foregoing explanation, Applicants respectfully submit that the specification adequately discloses the claim elements of claim 35 and hereby request withdrawal of the rejection of claim 35.

Claim 44

Claim 44, as amended herein, recites an apparatus for detecting electrical defects in a die on a semiconductor wafer. The apparatus comprises: a) means for applying charge to a predetermined region of the wafer such that electrically isolated structures in the die are raised to a voltage relative to electrically grounded structures; b) a probe, having significantly higher resolution than the means for applying charge, for obtaining voltage contrast data for a portion of the predetermined region containing such structures; c) means for determining reference voltages for such structures, should they be so charged and should they be non-defective; and d) means for analyzing the voltage contrast data to detect structures at voltages different from the reference voltages for such structures, thus determining which structures are defective. The Examiner

asserts that support for elements b) and d) (which previously was c)) of this claim are not found in the specification. Applicants respectfully disagree.

Concerning element b), as noted previously with respect to claims 9, 33, and 35, the specification discloses an electron beam for probing a portion of a predetermined region to obtain voltage contrast data. Applicants rely on the support provided for those claims, as detailed above, for support of this claim 44.

Concerning step d), the specification discloses a means for analyzing the voltage contrast data to detect structures at voltages different from the reference voltages for such structures, thus determining which structures are defective. Applicants' invention includes such a means for analyzing the voltage contrast waveforms by comparing a scanned image against a standard to determine if the structure contains non-functional (i.e. defective) elements. For example, Figure 1 discloses the system computer 36, the defect processor 56, acquisition pre-processor 48, and post processor 58, which, in addition to other elements disclosed in Figure 1, are utilized to detect defects in the structure. See also col. 14, line 15-*et seq.* for a discussion of each of these components and how they are utilized to analyze the voltage contrast data to detect structural defects. Applicants respectfully submit that the specification adequately discloses the claim elements of claim 44 and hereby request withdrawal of the rejection of claim 44.

Claim 48

Claim 48, as amended, recites an apparatus for detecting electrical defects in a die on a semiconductor wafer. The apparatus includes means for analyzing the voltage contrast data to detect structures at voltages different to predetermined voltages for such structures. Claim 48 sets forth that the means for analyzing voltage contrast data compares the voltage contrast data taken from the portion of the predetermined region with voltage contrast data obtained from a

corresponding region of another device. The Examiner asserts that support for this claim is not found in the specification. Applicants respectfully disagree. The specification sets forth means for comparing scanned information from one die with scanned information from another die. For example, this “die-to-die” mode is set forth in multiple locations within the specification, including Figure 3a and Col. 4, lines 55-63:

The inspection system has two modes of operation: die-to-die and die-to-database. In both modes, defects are detected by comparing an electron beam image derived from scanning the substrate against a standard. In die-to-die inspection, signals from two dice of the same substrate are compared with each other, while in die-to-database inspection the signal from one die derived from the electron microscope is compared with a signal that is derived from the database which typically is the one that was used to make the die.

Applicants respectfully submit that the specification adequately discloses the claim elements of claim 48 and hereby request withdrawal of the rejection of claim 48.

Claim 49

Claim 49, as amended, recites an apparatus for detecting electrical defects in a device on a semiconductor wafer, which has some structures at ground voltage and other structures at a floating voltage relative to ground. The apparatus comprises: a) a charged particle beam probe for scanning a charged particle beam across a predetermined region of a surface of the device in a series of spaced scan lines so as to intersect structures in the device; b) a secondary particle detector for obtaining voltage contrast data for the scan lines; and c) means for analyzing the voltage contrast data to determine the presence of a structure at a different voltage from a reference voltage for that structure should the structure be so charged and non-defective, thus identifying defective structures. The Examiner asserts that support for elements b) and c) of this claim are not found in the specification. Applicants respectfully disagree. The specification sets

forth particle detectors for obtaining voltage contrast data for the scan lines. As depicted most clearly in Figure 5, detectors 160, 117, and 129 are positioned to receive particles to determine the voltage contrast from the scanned line. The data received from the detectors is analyzed and defects are detected by comparing an electron beam image derived from scanning the substrate against a reference or standard (i.e. predetermined voltage for that structure). See col. 4, lines 54–57. Applicants respectfully submit that the specification adequately discloses the claim elements of claim 49 and hereby request withdrawal of the rejection of claim 49.

SUMMARY

Claims 9–51 were presented for examination. No claims were allowed. Claims 9–51 were rejected.

Claims 10, 12, 17, 33–41 and 44–49 are herein amended. Claim 28 is herein canceled without prejudice.

Reconsideration of this application as amended, and allowance of all pending claims, as amended, are hereby respectfully requested.

Applicants believe that the application is in condition for allowance of all claims remaining herein, and therefore an early Notice of Allowance is respectfully requested. If the Examiner believes that for any reason direct contact with Applicants' attorney would help

advance the prosecution of this case to finality, the Examiner is invited to telephone the undersigned at the number given below.

Respectfully submitted,

Meisburger et al

Date: March 22, 2002

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